Appendix F

Technical Memorandum: Impact of Increased Drainage through Wetland EE

Scope

HTDF Discharge Evaluation from Tailings Placement and Runoff for design rainfall events

Conditions/Assumptions

The proposed placement of tailings into the Humboldt Tailings Disposal Facility (HTDF) and the associated treatment of the HTDF discharge will result in some increase of flow from the HTDF into downstream wetlands and stream corridors. Although the total volume of increased discharge waters should have little impact on the wetland or stream systems, it is important to understand the change in the peak flows passing through this system before discharging to the Middle Branch Escanaba River about one mile below the HTDF discharge. This is especially important as this stream system passes by a residential area near the confluence with the river.

Flow hydrology for the HTDF and tributary lands was developed to determine flow estimates for a range of rainfall events. These runoff flows for the 2, 10, and 100-year storm events were used in hydraulics calculations to determine the potential change in stream depths near the residential properties.

Analysis Methodology

The *Haestad Methods* "PONDPACK" hydrologic program was used to calculate various design storm peak flows (using NRCS TR-55 methodology) generated by the drainage basin tributary to the Middle Branch Escanaba River. The drainage basin includes the HTDF and its tributary lands. Pond storage was included in the hydrologic calculation for both the existing condition and for the proposed condition which includes the additional outlet flow associated with the water treatment discharge.

For the hydrology calculations, the soils and land uses within the drainage basin were estimated. The soils are comprised of sandy loams, sands, outcrop, and other smaller soils which generally fall into the "B" or "C" hydrologic soil classification. The landscape is predominately wooded with some wetlands. This combination led to the use of a Runoff Curve Number (hydrologic parameter used in TR-55) of 60 for this evaluation. This, and other information was input into the program to model the characteristics of the drainage basin. The 2, 10, and 100-year rainfall event flows were then developed.

To the existing condition flows, an additional 539 gpm (1.2 cfs) was added to account for the additional HTDF discharge rate to model the proposed condition (from 246 gpm to 750 gpm plus a little to be conservative). The existing and proposed condition flows were then run through the *Haestad Methods* "FLOWMASTER" hydraulics program to determine the flow depths associated with these flows in the area of the residences. A trapezoidal channel of 3' bottom width and 2 ½ to 1 side-slopes was estimated as the stream geometry in the area of the residences. Although quite conservative (because the additional proposed condition flows will dissipate somewhat before reaching the residential area) the differences in stream flow depths can be compared between the existing and proposed conditions.

Results

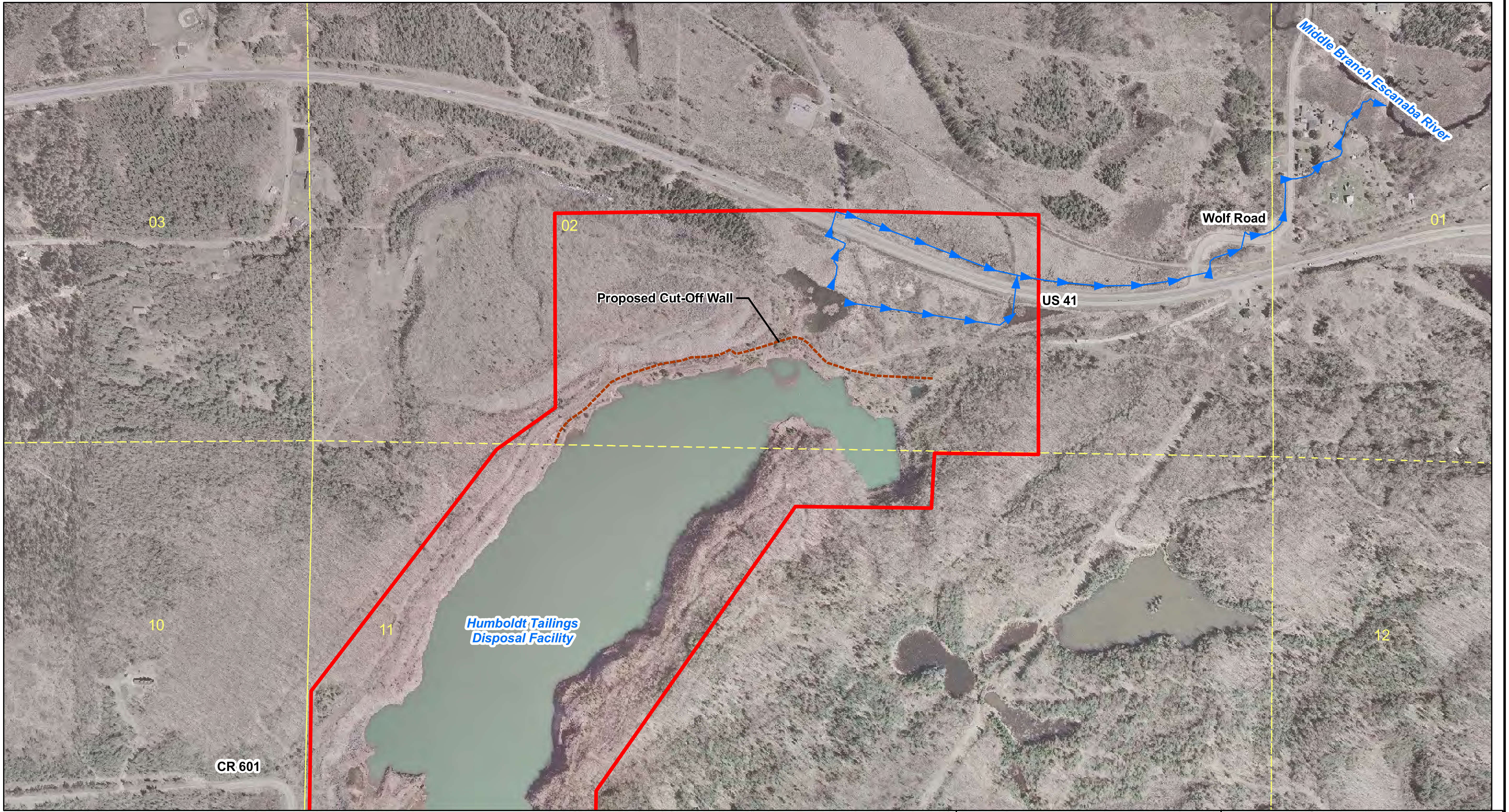
The results of the proposed HTDF discharge increase is summarized in the following tables,

	2-year		10-year		100-year	
	Flow	Depth	Flow	Depth	Flow	Depth
Existing Condition	13 cfs	1.06’	47 cfs	1.96’	168 cfs	3.45’
Proposed Condition	14.2 cfs	1.11’	48.2 cfs	1.99’	169.2 cfs	3.46’

The model input and output for these simulations are included in this documentation.

Conclusions/Recommendation

As discussed, the addition of the water treatment flow at the HTDF will increase peak flows downstream by something less than 1.2 cfs. This additional flow will increase the depth of water in the channel near the residences by as much as 0.05 feet for a 2-year event and as little as 0.01 feet for the 100-year event. The channel bank is estimated to be over two feet high, so the more frequent events which show the more significant depth of flow increase (2-year event) should have no effect on the residences as the water will remain in the channel. For larger, less frequent storms (100-year event), the depth of flow increase is so small as to be considered insignificant.



NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- PLSS Sections
- KEMC Project Location
- Approximate Surface Water Flow through Wetland EE
- Proposed Cut-Off Wall

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Foth
Foth Infrastructure & Environment, LLC

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	AKM	DATE: OCT. '08
APPROVED BY:	SVD1	DATE: OCT. '08
APPROVED BY:		DATE:

Kennecott
Eagle Minerals

FIGURE 1
HUMBOLDT MILL PROJECT
FLOW OF WETLAND EE

Scale: 0 250 500 Feet	Date: OCTOBER, 2008
Prepared by: BJW1	Project No: 06W003

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